

The Regulatory Environment: General Conditions

Because we are interested in exploring the extent by which incentive regulation influences digital infrastructure deployment, we have to control for the general regulatory environment. Since a complete picture of the regulatory environment cannot be determined from any one policy variable, we consider policies that differ substantially across states. The following set of general regulatory variables is used in the study: 1) unrestricted bypass; 2) entry of competitive access providers; 3) resale of local exchange services; 4) intraLATA competition; 5) deregulation of competitive services, and 6) earnings sharing applied to companies in the state. These variables take a value of 1 if the state Commission has taken a positive policy concerning that regulatory issue. We further include a variable that measures the number of large firms operating in the state.

No Restrictions on Bypass

A state's treatment of bypass can also give a general indication of the state's acceptance of competition within telecommunications. Bypass regulation involves several steps. First, the state must decide whether to allow bypass in general or not. Once a decision has been made to allow bypass of the local exchange facilities, the state must further decide whether or not to place restrictions on those providing the necessary equipment and technology.³⁵ Our variable *Not Restrict* takes a value of 1 when the Commission places no restrictions on bypass.

³⁵ Several states (e.g., Maine) do not allow formal bypass. Others require entry-certificates.

Competitive Access Providers

Competitive Access Providers' (CAPs) facilities allow for bypass of the local exchange network through the provision of transmission services between a building or complex and the point of presence of an IXC. This allows IXCs to avoid the access charges associated with connection to the LECs facilities, thus decreasing costs. Since access charges are currently about one-half of interexchange carriers' costs, CAPs are potentially formidable competitors in the LECs' most important line of business.

Authorizing CAP entry indicates a willingness on the part of the state to accept competition to some extent within the local exchange, at least for the larger users of telecommunications. This, however, raises other issues that the regulators must then face, such as how to allow the LECs to compete with the CAPs, regulation of CAPs, and interconnection of CAPs with LEC facilities. All of these and more must be addressed, as the regulators move toward more competition within the local exchange boundaries.

CAPs did not exist before 1984, and only began to be a factor in telecommunications by 1987. However, by 1991 there were 50 CAPs serving 30 cities, mainly large metropolitan areas, such as New York, Chicago, San Francisco, Los Angeles, and Washington D.C. There has also been some development in the smaller cities, such as Pittsburgh, Seattle, and Dallas. It is important to note though that all CAPs limit their coverage to urban areas, where it is the least expensive to provide services. Our variable *CAP* takes a value of 1 when the Commission allows CAP entry.

Resale of Local Exchange Services

The state's allowance of resale of services also gives an indication of its receptiveness towards freedom in pricing, and thus to competition. Three types of intrastate resale of services can be allowed: intra-state-interLATA toll services; intraLATA toll services; and within the local exchange. As resale is allowed across successively smaller geographic areas, the regulatory environment improves the degree of pricing efficiency, as different types of cross-subsidization schemes become untenable with widespread resale. By 1991, the vast majority of states allowed inter-LATA resale, although some states still limited this to MTS or WATS service. In addition, most states allowed resale of intraLATA services. Resale of local exchange services, however, is still generally not permitted, with only fifteen states allowing it in 1991, and in several of those states it is regulated. Our variable *Resale of LEX* takes a value of 1 when the state Commission allows such resale.

Intra-LATA Competition

Regulators must consider directly whether or not to allow for competition in their state. Their decisions regarding this, like resale, are made for three levels of competition: interLATA, intraLATA, and the local exchange. By 1986, most multi-LATA states had allowed for the competitive provision of intrastate interLATA services, with North Dakota and Pennsylvania allowing its provision in 1988 and 1987 respectively. A great deal of change has been seen over the same time period in intraLATA toll competition with only 18 states allowing for it in 1986, while by 1991 this was up to 33 states. The LATA was seen to be the border between the competitive long-distance market and the "natural monopoly" area of the local market. Thus

acceptance of competition within this border has been slower to occur. This slowness is even more pronounced in the competitive provision of local exchange: only four states, Idaho, Michigan, Montana, and New York, allowed it by 1991. Our variable *IntraLATA Comp* takes a value of 1 when the state Commission allows such competition.

Deregulation of Competitive Services

Finally, as Figure 1 shows, by 1993 deregulation of competitive services has been implemented in thirty states. The deregulation of competitive services usually involve the categorization of telecommunication services in three types: basic, emerging competitive or discretionary, and competitive. Price regulation is then designed in different form for each type of service. For example, a 1992 Michigan law eliminated firm-wide regulation, and directed the Michigan Public Service Commission to regulate products on a product by product level. Substantial price flexibility is then granted to competitive and emerging competitive or discretionary services, while basic services remain strictly regulated.³⁶ Our variable *Dereg of Comp Serv* takes a value of 1 when the Commission provided for pricing flexibility of competitive services.

Earnings sharing in the State

As we discuss above, most incentive regulation schemes are of a firm-by-firm nature. Usually, however, state Commissions grant firms the choice between adhering to an incentive

³⁶ See Appendix 4 for a survey of the states' experience with the deregulation of competitive services.

scheme or to continue under rate of return regulation. Thus, the existence of an incentive regulation scheme in the state implies a change in the state Commission's attitude towards regulation. We measure that change by creating a dummy variable equal to 1 if there is a firm in the state with an earnings sharing scheme.

VI. EMPIRICAL RESULTS

We start this section by analyzing the role of the demographic and economic factors. We then present and analyze estimates for the partial adjustment and baseline growth models. Our results are consistent with the following themes: first, economic and demographic characteristics of local exchange territories strongly influence the level of infrastructure deployment; second, excluding economic and demographic characteristics from the analysis biases predictions about the effects of incentive regulation schemes; third, price regulation greatly increases LEC's incentives to deploy fiber optic cable, SS7 equipped switches, and ISDN lines; finally, earnings sharing schemes provide weaker, and potentially counterproductive, incentives for the deployment of digital infrastructure.

Preliminaries

In Table 1 we provide descriptive regressions of infrastructure levels on economic and demographic variables. Table 1 shows that economic and demographic variables are important in explaining the cross sectional variation of infrastructure deployment. Indeed, across the four columns of Table 1 we see that the variables affect deployment in the expected manner. For example, fiber and ISDN deployment are positively correlated with population in large cities

(Urbanized). On the other hand, the deployment of ISDN and SS7 falls the more concentrated the LECs customers are in small towns (Urban). Rural population, on the other hand, does not have a consistent impact across the four measures of infrastructure.

Hourly construction wage, a measure of cost, is negatively correlated with the deployment of fiber, ISDN and SS7 (but insignificantly so for SS7). Concerning income measures, FIRE (finance, insurance and real estate) income seems to be a main determinant of digital infrastructure deployment, as it is positively and significantly correlated with the deployment of all infrastructure measures except ISDN. On the other hand, average per capita income in the LECs territory is positively correlated only with the deployment of ISDN, and the extent of manufacturing income in the LEC's territory is only significant in the deployment of fiber optic cable. The regional Bell operating companies seem to deploy more digital infrastructure than the other holding companies, except as it relates to switches.³⁷ While this result may reflect firm specific conduct, it may also reflect that RBOCs are located in areas with higher than average demand for high quality services. Firm specific effects will be dealt with when considering the determinants of growth rather than levels.

Finally, Table 1 shows that holding constant demographic and economic characteristics, the different measures of infrastructure have been growing at different speeds. ISDN and SS7 seem to have parallel growths, having annual growth rates of roughly 100%. ISDN and SS7 seem

³⁷ Since information on SS7, ISDN and DSPC switches is available only for Bell and GTE LECs, in the estimation of the determinants of these measures we include only a dummy for Bell operating companies.

to be at the same stage of diffusion as fiber was in 1987/1988. DSPC switches, on the other hand, have a slow growth rate, with only 1991 showing any substantial growth over 1989. To summarize, Table 1 suggests the economic and demographic characteristics of the LEC territories are important determinants of digital infrastructure deployment.

Partial Adjustment Model

We estimate the partial adjustment model (4) for fiber optic cable deployment for the period 1987-1991.³⁸ The empirical specification used in (4) involves all the regulatory and economic variables described in the previous section. We also create two interactions. First, because the effect of the incentive regulation could depend on the LEC's initial deployment conditions, we interact price cap and price freezes on the LEC's 1986 level of fiber deployment.³⁹ That is, we let the effect of price cap and price freezes vary, in principle, across LECs. A second set of interactions relate to the hypothesis that the effect of price regulation depends on whether it is coupled with an earnings sharing scheme. Thus, we create two interaction terms, one for price cap and earnings sharing, and another for price freeze and earnings sharing.

Table 2 reports four sets of results. The first two columns report the estimated values for the regulatory coefficients when demographic and economic variables are excluded. The third

³⁸ Because a potentially serially correlated lagged dependent variable is included in (4), the equation has to be estimated by instrumental variables techniques. Furthermore, the use of a lagged dependent variable implies losing one year (101 observations) of information.

³⁹ Because of the potential for correlation between the 1986 levels and the errors in further years, we treat the 1986 level as endogenous.

and fourth columns report the estimates when demographic and economic variables are included.⁴⁰ We observe, first, that the inclusion of demographic and economic variables has a large impact on the estimated parameters of the regulatory variables. Thus, attempts to explain determinants of fiber optic deployment without consideration of LEC specific economic and demographic considerations will provide biased predictions on the effects of incentive regulation schemes. The second and fourth column impose the constraint that price cap and price freezes have similar effects on fiber deployment. Again, we find that the exclusion of demographic and economic variables drastically affects the predicted effects of incentive regulation. For example, in both sets of estimates the inclusion of LEC specific demographic and economic variables reduces by almost half the impact of each of the price cap regulation variables.

Focusing now on columns 3 and 4 we find that the larger the LEC's initial deployment of fiber optic cable, the smaller the predicted effect of imposing price cap regulation.⁴¹ Furthermore, imposing both price caps and earnings sharing seems to have a detrimental effect. Although not very precisely estimated, it wipes out any advantages inherent to either price cap or earnings sharing. While the effect of price freezes is positive (particularly for LECs with at least a minimal fiber deployed in 1986), it is also not precisely estimated, except that the combination of price freeze and earnings sharing is, again, negative and both statistically and economically significant. In contrast to the effect of price regulation, earnings sharing alone does not seem to be associated

⁴⁰ To simplify the exposition, the estimated coefficients on the demographic variables are omitted from the Table.

⁴¹ The average 1986 fiber deployment (in logs) was 4.55

with increased deployment of fiber optic cable once LEC specific demographic features are taken into account.⁴²

Column 4 provides the estimates for the same partial adjustment model imposing the constraint that price cap regulation and price stabilization schemes have similar effects on fiber deployment. That is, we explore here the implications of price regulation in general, without separating between price cap and price freezes. Thus, columns 2 and 4 report the same coefficients for variables involving price cap as for those involving price freezes. Although the coefficient of price regulation now is smaller than that of price cap in column 3, it is still quite large and economically meaningful. The coefficient of the interaction of price regulation and initial deployment levels is negative but small and not statistically significant. On the other hand, the coefficient of the interaction of price regulation and earnings sharing is negative, and although it has large standard errors, its point estimate is large and economically meaningful. In both columns 3 and 4 the adjustment process coefficient is approximately .5, suggesting a relatively slow adjustment process.

Overall, columns 3 and 4 provide a very similar economic picture. Price regulation improves incentives to deploy fiber optic cable. Price cap regulation has a stronger effect than price stabilization schemes. The effect of price regulation falls with the LEC's initial levels of fiber optic deployment. Earnings sharing schemes, by themselves, seem to trigger some more fiber

⁴² Recall that to obtain the long run effect of a regulatory change we have to divide the estimated coefficient by the adjustment factor α .

deployment, although their effect is not statistically significant. Combining earnings sharing schemes with price regulation, however, seems to eliminate the extra incentives to deploy fiber optic cable. These results question the advantage of using earnings sharing schemes. Finally, Table 2 suggests that there may not be much difference between price cap and price freezes in promoting fiber optic deployment. Indeed, the explanatory power of columns 3 and 4 is almost the same. The difference is statistically insignificant when we take into account that the restricted model has three less explanatory variables.

To provide a summary statistic on the relative effect of incentive schemes we computed the expected increase in long run fiber deployment for those LECs that as of 1991 were not subject to any incentive regulation whatsoever.⁴³ Table 3 column 1 reports the predictions from using the estimated parameters from the unrestricted model in Table 2 column 3, while column 2 uses the estimated parameters reported in Table 2 column 4.

Looking at the second column of the table we find that, on average, subjecting those LECs to price cap regulation only would have increased their long run deployment of fiber optic cable by 100%, subjecting them to a price freeze only would have increased their long run

⁴³ We compute the expected change in long run fiber deployment as follows. Let the portion of $X\beta$ dealing with incentive regulation given by $\beta_1 \text{PriceCap} + \beta_2 \text{PriceCap} * \text{Fiber}_{98} + \beta_3 \text{PriceCap} * \text{Earnings sharing} + \beta_4 \text{PriceFreeze} + \beta_5 \text{PriceFreeze} * \text{Fiber}_{98} + \beta_6 \text{PriceFreeze} * \text{Earnings sharing} + \beta_7 \text{Earnings sharing}$. The effect of only imposing price caps on a LEC currently subject to no incentive scheme regulation, is given by $(\beta_1 + \beta_2 \text{Fiber}_{98})/\alpha$, where α is the partial adjustment coefficient. The effect of simultaneously imposing price cap regulation and an earnings sharing scheme would be given by $(\beta_1 + \beta_2 \text{Fiber}_{98} + \beta_3 + \beta_7)/\alpha$. The effects of implementing price stabilization plans can be derived analogously. The effects of implementing only an earnings sharing scheme is given by the coefficient of earnings sharing (divided by α).

deployment by 40%, while introducing earnings sharing only would have increased their long run fiber deployment by 50%. On the other hand, combining earnings sharing with either type of price regulation eliminates any of the advantages of incentive regulation. These results hold when looking at column 1 of the Table where we impose the constraint that price cap regulation has the same effect as price freezes. Here again we find that combining price regulation with earnings sharing degrades the incentives faced by the LECs to increase their fiber deployment.

A Baseline Growth Model

Since SS7 and ISDN seem to have a very similar evolution, we estimate equation (5) for these two measures jointly, imposing the constraint that the regulatory variables (both incentive regulation and general regulatory framework) have similar effects.⁴⁴ DSPC switches and Fiber are estimated separately.⁴⁵ Furthermore, because there is strong evidence that GTE has had a very different strategy of deploying digital switches than other operating companies,⁴⁶ we let the coefficients of the incentive schemes in the DSPC switches equation differ for GTE.⁴⁷ Table 4

⁴⁴ We do not restrict the coefficient of the demographic variables nor of the interactions with initial (1989) levels. Similarly, we do not restrict the constant to be the same across the two equations.

⁴⁵ Because of data limitation, SS7, ISDN and DSPC switches are estimated for the period 1990/1991. We use 1989 as the base. Furthermore, recall that for these three digital infrastructure measures we have information on a state by state level only for RBOCs and GTE operations.

⁴⁶ See L.K.Ruiz and G.A. Woroch, "GTE's Capital Investment Profile: An Empirical Assessment," GTE Laboratories, TC-0180-03-92-419, March 1992. This study suggests that GTE's ownership of equipment manufacturer affected its deployment decision.

⁴⁷ The GTE specific estimates are the result of interacting the incentive scheme variable with a dummy for GTE.

reports the results of estimating the baseline growth model for fiber optic deployment, for both the restricted and unrestricted specifications. Table 5 reports results for the restricted specification for ISDN, SS7 and DSPC switches.⁴⁸

Table 4 shows that for Fiber deployment, price regulation has a large and statistically significant effect on the growth of fiber optic over the baseline year. Furthermore, that effect, as in Table 2, falls with the initial level of infrastructure deployed by the LEC. The coefficient of the cross-product of price regulation with earnings sharing is negative, but not statistically significant. Earnings sharing by itself has a negative effect and statistically significant effect on fiber optic growth over the baseline year. Finally, Bell operating companies do not seem to deploy fiber optic cable differently than the independent companies. As in Table 2, there do not seem to be important differences between price cap regulation and price freeze schemes. Although the point estimates involving price cap or price freezes in column 2 are slightly different, the explanatory power (and the log-likelihood) of the two columns is approximately the same. Thus, we can conclude, again, that during the period in question, the effect of price cap regulation on infrastructure deployment was not significantly different from the effect of price freezes.⁴⁹

⁴⁸ The sample size for ISDN, SS7 and DSPC switches (152 observations over two years involving only Bell and GTE companies) limits the generality of the specification that can be used. In particular, interactions among price caps and earning sharing cannot be separated from a single state dummy (California). The large number of observations for fiber optic cable deployment does not limit the identification of any of these interactive effects.

⁴⁹ Recall that during the period under consideration, there were no substantial inflationary pressures. Thus, as discussed above, the main difference between the two regulatory approaches would have been the potential for rebalancing inherent in price cap regulation.

In Table 5 we present the results for SS7, ISDN and DSPC switches. In general, the results are as in Table 4. Price regulation has a strong impact on the growth of ISDN and SS7. Price regulation, however, does not seem to have an effect on the deployment of DSPC switches, except for GTE, where we find a negative effect. The cross-products with earnings sharing are negative but not significant. While the point estimates of earnings sharing by itself are positive, they are small and their standard errors are large. Finally, the coefficient of Bell operating companies is statistically significant only in the ISDN equation.

Finally, Table 6 provides the predicted change over the baseline year of what would be achieved by imposing incentive regulation on companies that in 1991 had no incentive scheme. The main finding is that price regulation provides stronger investment incentives than earnings sharing schemes. Indeed, price regulation by itself provides more than 100% increase in deployment over the base year (except for DSPC switches), while earnings sharing by itself increases ISDN and SS7 only by 20%, an economically small (and statistically insignificant) effect, and reduces investment incentives in fiber optic cable by almost 50%.

As in the partial adjustment model estimates, combining earnings sharing and price regulation reduces the incentives for deploying fiber optic cable. On the other hand, such combination does not have an economically or a statistically significant impact over that obtained by price regulation alone.⁵⁰ Thus, our two modeling approaches provide the same conclusion on

⁵⁰ Recall that from Table 5, the coefficients involving earnings sharing are not significantly different from zero. Thus, in Table 6, the simulated values for the effects of price regulation and price regulation with earnings sharing are not statistically different.

the relative merits of price regulation and earnings sharing schemes. These results suggest, then, that there is nothing to be gained from the perspective of infrastructure deployment by the addition of earnings sharing to a price cap plan. Significant administrative costs would be added, though.

VII. CONCLUSION

Divestiture unleashed a wealth of experimentation by state regulators of local exchanges. Judging from the variety of choices made, there exists no consensus about the optimal goals for regulators to pursue, nor about the most efficient means to achieve clearly defined goals. This variety of regulatory structures across hundreds of local exchange carriers provided the natural experiment for this study's analysis.

This study focuses on the influence of regulatory rules on investment in modern infrastructure. We collected and analyzed investment at every large local exchange company in the United States. We modeled and identified the contribution of state regulatory policies from that of other local economic and demographic factors of the service territories of LECs. We especially focused on the effects of two regulatory rules of current policy debate, price regulation and earnings sharing.

We showed that both demographic and regulatory factors influenced observed deployment patterns. Neither alone provides an accurate picture of the determinants of infrastructure growth. Moreover, the absence of accounting for demographic and economic factors can bias analysis of

the impact of regulatory factors and lead to inaccurate inferences. While this finding is not surprising, we highlight it because of how frequently it is forgotten in theoretical and empirical studies of pricing regulation.

Our main findings are that price regulations influence the level of deployment of modern equipment at the local exchange level. Moreover, the direction and magnitude of the influence are consistent with economic theory. The pattern persists in different degrees for three measures of modern infrastructure deployment -- fiber, ISDN lines, and SS7 switches. The results also hold for fiber deployment under alternative specifications of the statistical relationship between regulatory incentives and infrastructure deployment. These effects are not small. Had every state regulators adopted such pricing schemes, fiber deployment would be at least 75 percent higher, and probably more, in those local exchanges that did not adopt such schemes.

If deployment of modern equipment is a primary goal of state agencies, our research shows that pricing regulations must play an important role in achieving that goal. Our research does not find similar evidence about earnings sharing arrangements. Accordingly, we are less sanguine about the use of earnings sharing schemes as a tool to achieve modern infrastructure deployment. We do anticipate the present variety of regulatory regimes to persist after the experiences under different incentives schemes become widely known. If agencies act on these observations, pricing regulations will become the national norm, and eliminate the interesting, yet costly, natural experiment that made this study feasible.

**TABLE 1: INFRASTRUCTURE INVESTMENT
EXPLAINED BY TERRITORY SPECIFIC AND DEMOGRAPHIC FACTORS
(T-STATISTICS IN PARENTHESIS)**

ENDOGENOUS VAR YEARS	FIBER¹ 1986-1991	ISDN LINES² 1989-1991	TOTALSS7³ 1989-91	SWITCHES⁴ 1989-1991
NUMBER OBSERVATIONS	606	228	228	228
METHOD	OLS	TOBIT	TOBIT	OLS
R-SQUARED	0.752	NA	NA	0.792
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CONSTANT	0.43 (0.09)	-27.86 (-2.35)	-31.05 (-2.20)	-5.06 (-2.48)
LOG LAND MASS	0.0062 (0.07)	0.49 (2.29)	-0.53 (-2.11)	0.045 (0.96)
LOG URBANIZED POP	0.11 (2.16)	1.14 (5.00)	-0.10 (-0.46)	0.0021 (0.07)
LOG URBAN POP	0.11 (1.11)	-0.61 (-2.40)	-0.56 (-1.90)	-0.0004 (-0.007)
LOG RURAL POP	-0.04 (-0.37)	-0.29 (-1.09)	0.74 (2.38)	0.13 (1.98)
LOG PERCAP INCOME	-0.39 (-0.80)	2.53 (2.04)	1.85 (1.24)	0.067 (0.33)
LOG MANUFACTURING	0.31 (3.06)	0.45 (1.27)	0.11 (0.26)	0.093 (1.23)
LOG FIRE	0.44 (3.60)	-0.33 (-0.78)	1.13 (2.40)	0.35 (4.19)
LOG CONSTR WAGE	-2.12 (-3.79)	-3.31 (-2.52)	-1.58 (-1.02)	0.38 (1.22)
NUMBER OF LEC	0.19 (2.39)	0.15 (0.94)	0.34 (1.80)	0.071 (1.66)
BELL	1.54 (6.23)	3.38 (8.88)	3.19 (5.02)	-0.17 (-1.40)
GTE	0.34 (1.66)	NA	NA	NA
Y87	1.37 (5.93)	NA	NA	NA
Y88	3.48 (15.10)	NA	NA	NA
Y89	4.06 (17.55)	NA	NA	NA
Y90	4.41 (19.08)	1.35 (3.96)	1.93 (4.52)	0.17 (2.01)
Y91	4.74 (20.40)	2.17 (6.42)	2.79 (6.54)	0.47 (5.54)
SIGMA	NA (16.21)	1.81 (16.21)	2.01 (13.64)	NA

NOTES:

¹ Fiber is number of fiber miles in LEC territory.

² ISDN is total number of ISDN lines in LEC territory.

³ SS7 is total number of SS7394 and SS7317 switches in LEC territory.

⁴ Switches is total number of DSPC switches in territory.

TABLE 2: PARTIAL ADJUSTMENT MODEL
LOG (FIBER)¹
TWO STAGE LEAST SQUARES WITH ROBUST STANDARD ERRORS²
1987-1991
(T-STATISTICS IN PARENTHESES)

SPECIFICATION	GENERAL	RESTRICTED	GENERAL	RESTRICTED
DEMOGRAPHIC VARS	NO³	NO³	YES⁴	YES⁴
R-SQUARED	.563	.561	.772	.771
LOG OF LIKELIHOOD	-1036.32	-1037.49	-871.941	-873.636
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PRICECAP	2.64 (3.38)	2.02 (3.08)	1.75 (3.53)	0.84 (2.04)
PRICECAP & FIBER86	-0.45 (-3.65)	-0.32 (-2.82)	-0.31 (-3.26)	-0.12 (-1.38)
PRICECAP & E. SHARING	-0.52 (-0.81)	-0.59 (-1.02)	-0.77 (-1.59)	-0.48 (-1.35)
PRICE FREEZE	-1.62 (-0.61)	2.02 (3.08)	-0.18 (-0.38)	0.84 (2.04)
PRICE FREEZE & FIBER86	0.35 (0.72)	-0.32 (-2.82)	0.11 (1.28)	-0.12 (-1.38)
PRICE FRZE & E. SHARING	-1.55 (-1.36)	-0.59 (-1.02)	-0.73 (-2.20)	-0.48 (-1.35)
E. SHARING ON COMPANY	0.61 (2.32)	0.60 (2.30)	0.29 (1.41)	0.29 (1.39)
NOT RESTRICT	0.52 (1.93)	0.53 (2.02)	0.29 (1.59)	0.32 (1.67)
COMP. ACC PROVIDER	0.32 (0.92)	0.31 (0.89)	-0.11 (-0.38)	-0.10 (-0.33)
RESALE OF LEX	-1.00 (-3.24)	-0.97 (-3.17)	-0.57 (-2.62)	-0.55 (-2.49)
INTRALATA COMP.	-0.27 (-1.59)	-0.25 (-1.49)	-0.29 (-2.17)	-0.25 (-1.85)
DEREG. OF COMP. SERV.	-0.060 (-0.28)	-0.060 (-0.29)	0.24 (1.62)	0.22 (1.51)
E. SHARING IN STATE	0.76 (2.65)	0.70 (2.54)	0.56 (2.91)	0.43 (2.31)
CAP & DER. COMP. SERV.	0.42 (0.94)	0.45 (0.99)	0.48 (1.29)	0.38 (1.07)
1 - ALPHA	0.61 (2.67)	0.59 (2.71)	0.56 (2.39)	0.49 (2.00)

NOTES:

¹ Fiber represents the amount of fiber in fiber miles in LEC territory.

² Estimated equation is $Y = XB + (1-ALPHA)*YHAT(-1)$, where $B/ALPHA$ = optimal investment.

³ The following exogenous variables are not shown in columns 1, 2: CONSTANT, COMPANY COUNT, BELL, GTE, Y88, Y89, Y90, Y91.

⁴ The following exogenous variables are not shown in columns 3, 4: CONSTANT, COMPANY COUNT, LOG LAND, LOG URBANIZED POP, LOG URBAN POP, LOG RURAL POP, LOG CONSTRUCTION WAGE, LOG PERCAPITA INCOME, LOG MANUFACTURING, LOG FIRE, BELL, GTE, Y88, Y89, Y90, Y91.

**TABLE 3: AVERAGE PREDICTED EFFECT OF INCENTIVE REGULATION
ON LEC UNDER RATE OF RETURN AS OF 1991
PERCENTAGE CHANGE IN FIBER¹
PARTIAL ADJUSTMENT MODEL
(N=66)**

REGULATORY CHANGE	RESTRICTED ESTIMATION	UNRESTRICTED ESTIMATION
PRICE CAP	77%	96%
PRICE CAP & EARNINGS SHARING	39%	10%
PRICE FREEZE	77%	42%
PRICE FREEZE & EAR. SHARING	39%	-37%
EARNINGS SHARING ALONE	59%	52%

Notes:

¹ Restricted estimation derived from Table 2 column 4. Unrestricted estimation derived from Table 2 column 3.

**TABLE 4: FIBER OPTIC CABLE,BASELINE GROWTH MODEL
TWO STAGE LEAST SQUARES WITH ROBUST STANDARD ERRORS
T-STATISTICS IN PARENTHESES
1987/1991**

VARIABLE¹	UNRESTRICTED	RESTRICTED
PRICE CAP REG	4.25 (5.90)	3.78 (5.58)
PRICE CAP REG × INITIAL LEVEL	-.69 (-6.02)	-.65 (-5.77)
PRICE CAP REG × EARN SHARING	-.25 (-.31)	-.25 (.44)
PRICE FREEZE	2.07 (2.18)	3.78 (5.58)
PRICE FREEZE × INITIAL LEVEL	-.44 (-3.17)	-.65 (-5.77)
PRICE FREEZE × EARN SHARING	.05 (.07)	-.25 (.44)
EARNINGS SHARING	-.48 (-1.59)	-.47 (-1.56)
BELL DUMMY	-.10 (-.30)	-.19 (-.58)
GTE DUMMY	1.78 (5.56)	1.78 (5.59)
TIME TREND	.76 (10.74)	.75 (10.67)
LOG LIKELIHOOD	-1051.30	-1052.35
R-SQUARED	.44	.44
# OF OBSERVATIONS	505	505

¹ The coefficients of the following variables are not shown: CONSTANT, NUMBER OF LEC, LOG LAND, LOG URBANIZED POP, LOG URBAN POP, LOG RURAL POP, LOG CONSTRUCTION WAGE, LOG PERCAPITA INCOME, LOG MANUFACTURING, LOG FIRE.

TABLE 5: BASELINE GROWTH MODEL
RESTRICTED ESTIMATION: PRICE CAP=PRICE FREEZE
TWO STAGE LEAST SQUARES WITH ROBUST STANDARD ERRORS
T-STATISTICS IN PARENTHESES

VARIABLE ¹	SS7 ¹ 1990/91	ISDN ¹ 1990/91	DSPC SWITCHES 1990/91	
			BELL	GTE ²
PRICE REGULATION	1.59 (4.79)		-.59 (-2.61)	-1.98 (-2.70)
PRICE REGULATION × INITIAL LEVEL	-.61 (-3.98)	-.21 (-2.11)	.18 (3.26)	.39 (1.80)
PRICE REGULATION × EARN SHARING	-.05 (-.10)		-.13 (-1.12)	NA
EARNINGS SHARING	.20 (.84)		.01 (.24)	.26 (1.17)
BELL DUMMY	.28 (.76)	.75 (2.09)		-.09 (-1.10)
GTE DUMMY	NA	NA	NA	NA
TIME TREND	.62 (2.97)	.75 (2.08)		.30 (7.55)
LOG LIKELIHOOD		-493.755		1.864
R-SQUARED	.36	.43		.43
# OF OBSERVATIONS	152	152		152

NOTES:

¹ Jointly estimated

² GTE column reflects coefficients of interacting regulatory variables with a GTE dummy.

³ The coefficients of the following variables are not shown: CONSTANT, NUMBER OF LEC, LOG LAND, LOG URBANIZED POP, LOG URBAN POP, LOG RURAL POP, LOG CONSTRUCTION WAGE, LOG PERCAPITA INCOME, LOG MANUFACTURING, LOG FIRE.

**TABLE 6: AVERAGE PREDICTED EFFECT OF INCENTIVE REGULATION
ON LEC UNDER RATE OF RETURN AS OF 1991¹
PERCENTAGE CHANGES
BASELINE GROWTH MODEL
(N=66)**

REGULATORY CHANGE	SS7	ISDN	FIBER	SWITCHES	
				BELL	GTE
PRICE CAP OR PRICE FREEZE	111%	114%	127%	18%	-72%
PRICE CAP OR PRICE FREEZE * EARNINGS SHARING	126%	129%	55%	7%	-57%
EARNINGS SHARING ALONE	20%	20%	-47%	1%	27%

NOTE:

¹ Estimates derived from Tables 4 and 5.

FIGURE 1: THE STATES REGULATORY ENVIRONMENT

STATES REGULATORY ENVIRONMENT

NUMBER OF STATES WITH SPECIFIC POLICY

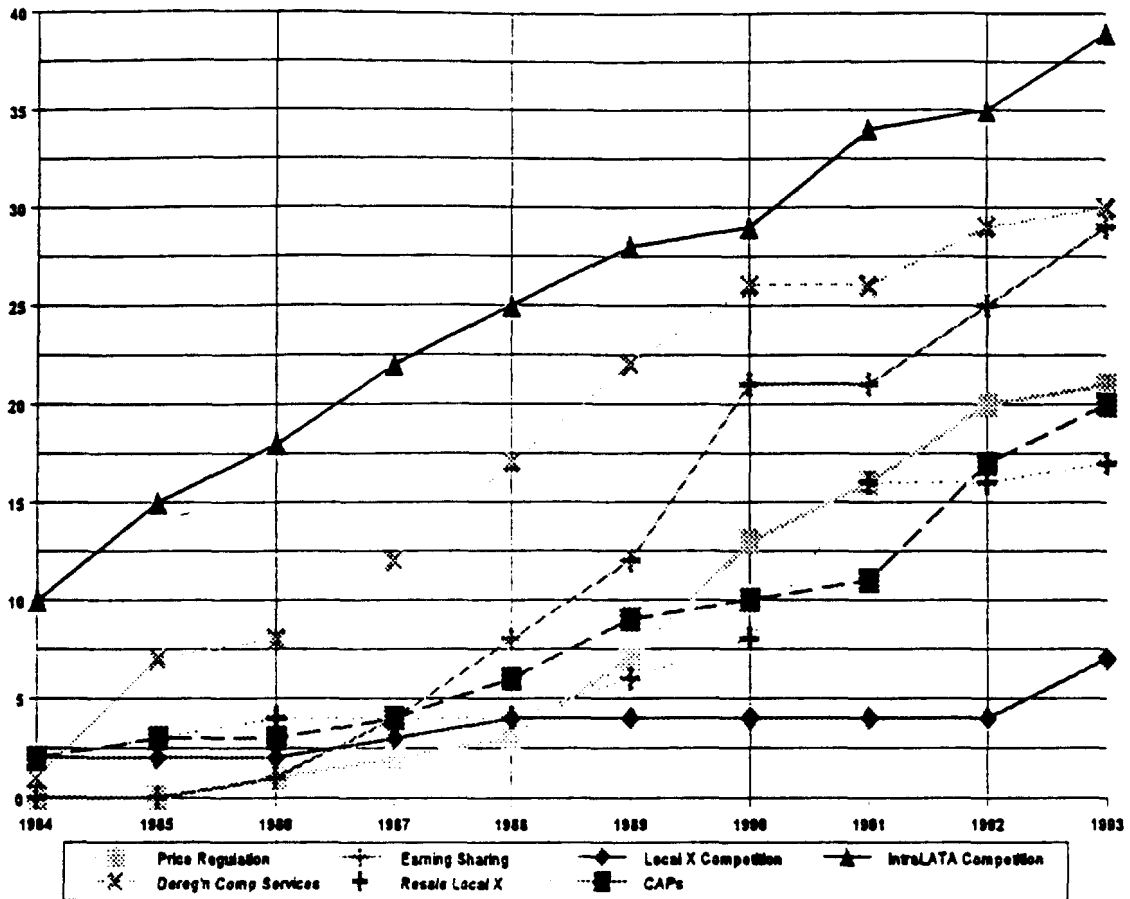
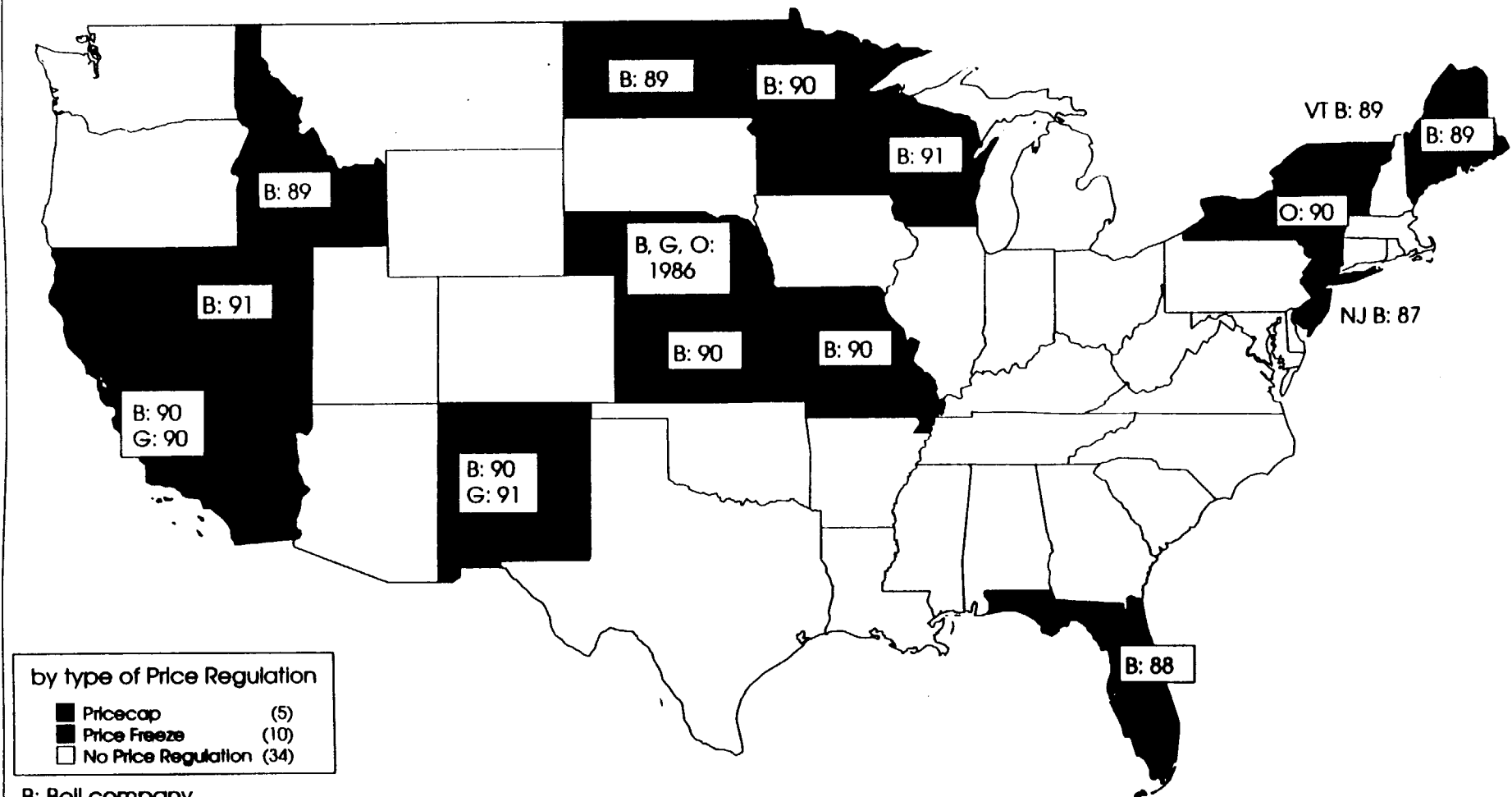


FIGURE 2: FIRMS SUBJECT TO PRICE REGULATION AS OF 1991

Firms subject to Price Regulation as of 1991
(Year of adoption)



B: Bell company
G: GTE company
O: Other - NE: Lincoln Tel., NY: Rochester Tel.